

REMARKS

This paper is in response to the official action of October 4, 2005, wherein claims 1 and 3-6 were rejected by the examiner based on Mooji et al (U.S. Patent No. 5,861,091) and Bard et al (Electrochemical Methods, John Wiley & Sons) and claim 2 was rejected based on these references in view of Holland (U.S. Patent No. 1,511,967). These rejections are respectfully traversed, as the cited references do not suggest the present invention. Reconsideration is requested.

Mooji et al discloses a general principle of zinc dissolution by bringing a source of zinc ions (anode) and a zinc dissolution accelerating metal (the cathode) into electrical contact with each other to create a galvanic cell as recognized by the examiner (see Fig. 14 and column 4, lines 58 through column 5, line 33 of Mooji et al.).

In Mooji et al, the anode and cathode metals are disposed in different vessels and thus are not in direct physical contact with each other. On the other hand, Bard et al discloses that mass transfer depends on convection (Fig. 17, Fig.1.3.2). The examiner states that it is obvious that the convection is caused by shaking, vibration, or rotation. The examiner concluded that the present invention in Claim 1 is obvious from Mooji et al in view of Bard et al.

In the prior art, zinc ions are usually supplied by convection and/or circulation such as by pump. However, the efficient supply of zinc ions necessary for efficient zinc plating cannot be achieved by such circulation. The present inventors have found that supply of zinc ions is remarkably enhanced by the method wherein a vessel or separate vessels containing directly or indirectly electrically connected source of zinc ions and a zinc dissolution accelerating metal, both in the form of grains or chips, is or are shaken, vibrated or rotated in a plating solution.

This process cannot be inferred from the simple and general disclosure of Bard et al that the mass transfer such as convection will have an effect on the electrolytic cells. Bard

enumerates a number of conceivable factors which might affect the electrochemical processes, but neither teaches whether the mass transfer or convection has a favorable effect or adverse effect on electroplating, nor teaches any concrete means of enhancing the efficiency of zinc ion supply.

In the present invention, it has been unexpectedly found that a mechanical method as defined in claim 1 of accelerating the dissolution of zinc ions is very effective, as compared to conventional methods. Mere convection or circulation of the solution such as by pump is not sufficient. The grains or chips of the zinc source and the zinc ion dissolution are separately or altogether mechanically contacted to each other, which causes friction between the grains or chips which greatly accelerates dissolution of zinc ions (see [0012] of the specification). There is no teaching of this respect in any of Mooji et al and Bard et al.

Specifically referring the data in Examples ([0015]) of the specification of this application, tests were conducted in a system including a zinc electroplating bath and a zinc dissolution bath in which the solution overflowing from the electroplating bath is fed to the dissolution bath and the dissolved zinc solution is pumped back to the electroplating bath. The tests in Tables 1 and 2 were conducted in this same system using a common vessel (a barrel) containing the grains of zinc source and grains of dissolution accelerating metal (Table 1) and separate vessels (barrels) respectively containing the grains of zinc source and grains of dissolution accelerating metal (Table 2).

The working example of this invention and the comparative examples are different only in that the vessel or vessels were rotated (examples of the invention) or not (comparative examples) and thus they all rely on the convection and circulation of the solution. From these tables, it is apparent that the efficiency of the examples is much superior to the comparative examples.

For example, comparing Example 1 with Comparative Example 1, the zinc ion dissolution rate was maintained at the initial level in the example 1 after five times

dissolution, while the dissolution rate decreased with lapse of time in the comparative example 1. All other examples and comparative examples show similar behaviors. This substantial difference may be explained that the circulation of the solution does not cause the grains of zinc source and the dissolution accelerating metal to move and the surface of the grains is gradually inactivated with laps of time.

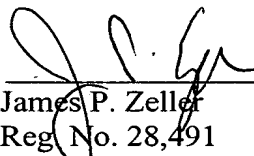
Accordingly, it is submitted that the present invention is not obvious over the cited references.

Should the examiner wish to discuss the foregoing or any matter of form in an effort to advance this application towards allowance, he is urged to telephone the undersigned at the indicated number.

Respectfully submitted,

MARSHALL, GERSTEIN & BORUN LLP

January 4, 2006

By: 
James P. Zeller
Reg. No. 28,491
Attorneys for Applicants

6300 Sears Tower
233 South Wacker Drive
Chicago, Illinois 60606-6357
(312) 474-6300